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A preliminary glossary of artificial intelligence in radiology

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The use of artificial intelligence (AI) and deep learning is progressively gaining credibility in medicine, particularly within the radiological sciences (1). In particular, convolutional neural networks (CNN) can solve even complex cases and provide diagnoses within short time frames with a level of accuracy that occasionally surpasses the capabilities of radiologists. In this vein, data scientists and data engineers have appeared before radiology society conferences and delivered interesting talks regarding AI. As a result of the use of AI in radiology, previously unheard-of terminology has been introduced to the field that will become common language in the near future. Thus, this paper seeks to define many of these common terms for the benefit of radiology practitioners.

In their Canadian Association of Radiologists white paper on AI, Tang et al. very briefly mentioned an AI glossary (2). However, to the best of this author's knowledge, this paper presents the first brief, practical glossary for AI in radiology in the English literature that can serve as a reference prototype for the purpose of simplifying the complex terminology. It is especially designed for radiology trainees and experienced radiologists who have an interest in AI. It is important to note that this is not intended as a precise or exhaustive glossary; therefore, some data science-specific, non-radiological terminology has been excluded from this paper. Instead, the most frequently encountered terms that relate to radiology are included below.

Artificial intelligence (AI): Highly developed computer systems that have the ability to perform tasks that normally require human intelligence, such as visual perception, translation, speech recognition, image interpretation, interaction with humans (e.g. chatting), and decision-making. AI, sometimes called machine intelligence, is a type of intelligence demonstrated by machines (3,4).

Algorithm: Step-by-step instructions completed by computers, including simple or complex tasks, such as setting reminders or identifying a group of people within a crowd (4).

Backpropagation: The manner in which CNNs learn. They are able to recognize the differences between output and desired output and adjust calculations in reverse order of execution (5).

Big data: A term for extremely large datasets that can be analyzed to reveal patterns, trends, and associations. Big data includes electronic medical records, which contain huge digital imaging archives, pathology department and laboratory archives, and millions of digital clinical notes and diagnoses (4).

Blackbox: CNN's (algorithm's) unknown internal working pattern (6). Essentially unknown processing, especially within hidden layers. For example, it is difficult to comprehend how a CNN reaches an outcome.

Cluster analysis (clustering): The task of grouping a set of objects similar to each other into clusters (7).

Convolutional neural network (CNN): Deep learning intelligence network commonly used in diagnostic imaging (7).

Data mining: A process used to extract usable data from a larger set of raw data. Data mining algorithms are particularly beneficial on complex datasets with a large number of variables and samples (8).

Data science: A field that uses scientific methods, processes, algorithms, and systems to extract knowledge and insights from data in various forms, both structured and unstructured. Similar to data mining (7).

Data scientist: A person who analyzes and interprets data (9).

Deep learning (machine learning): "A set of automatic pattern recognition methods that have been successfully applied across various problem domains, including biomedical image analysis" (10).

Diagnosis (artificial intelligence): Concerned with the development of algorithms and techniques that are able to show whether the behavior of an AI system is correct

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or faulty. If the system is not functioning correctly, the algorithm should be able to show it as accurately as possible. Should not be confused with computer-aided diagnosis (11).

Hidden layer: An internal layer of neurons in a CNN not dedicated to input or output (1).

Hidden unit: A neuron that resides in a hidden layer in a CNN (1).

Machine learning: The scientific study of algorithms and statistical models that computer systems use to effectively perform a specific task without using explicit instructions, similar to deep learning, but less comprehensive and it is regarded as subset of AI (1).

Model: Structure of a CNN that allows the transformation of input data into output (2).

Python (programming language): One of the most frequently used programming languages in AI. Created by Guido van Rossum, a Dutch data scientist, and first released in 1991 (11,12).

R (programming language): One of the programming languages designed for statistical computing, widely used by data scientists and statisticians (12).

Radiomics: A nearly limitless supply of imaging biomarkers which could potentially aid cancer detection, diagnosis, evaluation of prognosis, assessment of response to treatment, and monitoring of the disease status (13).

Representation learning: Subtype of machine learning; algorithms can learn the features needed to classify data (2).

Robotics: The study of robots. Robots are machines that can be used to do jobs. Some robots can do work by themselves. Other robots must always have a person telling them what to do (14).

Segmentation: Process of picturing the margins of a lesion or organ in an image (2).

Testing: Evaluating the performance of a selected model (2).

Validation: Adjusting the model parameters using subsets of datasets (2).

Virtual assistant: A software virtual agent can perform tasks or services for an individual based on verbal commands. Sometimes the term "chatbot" can be used to refer to virtual assistants Some virtual assistants are able to interpret human speech and respond via synthesized voices. Users can ask their assistants questions, control home automation devices and media playback via voice, and manage other basic tasks, e.g. email, to-do lists, and calendars with verbal commands (15).

In summary, implementation of AI in day-to-day practice is very much impending in the field of radiology. This preliminary AI glossary should be helpful for radiology trainees and experienced radiologists to begin to understand AI glossary jargon.

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